NIAGARA MOHAWK POWER CORPORATION

NINE MILE POINT NUCLEAR STATION

UNIT II OPERATIONS

02-LOT-001-272-2-01 Revision 6

TITLE: DIGITAL RADIATION MONITORING SYSTEM

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Summary of Pages

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TRAINING DEPARTMENT RECORDS ADMINISTRATION ONLY

VERIFICATION:

DATA ENTRY:

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5/3/370 23pp

I. TRAINING DESCRIPTION

A. Title of Lesson: Digital Radiation Monitoring System

B. Lesson Description: This lesson contains information pertaining to the Digital Radiation Monitoring System. The scope of this training is defined by the learning objectives and in general covers the knowledge requirements of a Licensed Control Room Operator.

C. Estimate of the Duration of the Lesson: 1.5 hours

D. Method of Evaluation, Grade Format, and Standard of Evaluation: Written examination, passing grade of 80% or greater.

E. Method and Setting of Instruction: This training should be conducted in the classroom.

F. Prerequisites:

1. Instructor:

a. The instructor shall be familiar with the lesson materials and have achieved the necessary instructor certification in accordance with NTP-16.

2. Trainee:

a. Initial License Candidate - In accordance with eligibility requirements of NTP-10.

G. References:

1. Technical Specifications:

a. 3/4.3.7.1, Radiation Monitoring

b. 3/4.3.10, Radioactive Liquid Effluent

c. 3/4.3.7.11, Radioactive Gaseous Effluent Monitoring Instrumentation

2. Procedures

a. N2-OP-79, Radiation Monitoring System

3. NMP-2 USAR

a. Vol. 25, Chapters 11 and 12

II. REQUIREMENTS

A. AP-9, Administration of Training

B. NTP-10, Training of Licensed Operator Candidates

III. TRAINING MATERIALS

A. Instructor Materials:

1. Training Record
2. Instructor's working copy of the lesson plan.
3. Whiteboard and Markers
4. Overhead Projector
5. Transparencies as needed
6. Flip Chart (if necessary)
7. Copy of trainee handouts
8. Trainees Course Evaluation Forms

B. Trainee Materials:

1. Handouts
2. Paper or Notebook
3. Pen or Pencil

IV. EXAM AND MASTER ANSWER KEYS

A. Will be generated and administered as necessary. They will be on permanent file with the designated clerk.

V. LEARNING OBJECTIVES

Upon satisfactory completion of this lesson, the trainee will demonstrate the knowledge to: |6

A. Terminal Objectives:

TO-1.0 Operate the DRMs Computer (2720020101)

TO-2.0 Monitor the Area/Process Radiation Monitoring remote indications (Kerics) (2720030101)

TO-3.0 Perform the actions for a Radiation Monitoring System alarm. (2000610501)

TO-4.0 Perform the actions required for a high radiation or high airborne activity condition in general or local areas. (2009180601, 2009170601)

B. Enabling Objectives:

EO-1.0 Explain the purpose of the Digital Radiation Monitoring System.

EO-2.0 Describe the function and operation of each of the following major Components and Auxiliary Systems of the Digital Radiation Monitoring System.

a. Radiation Detection Subsystem
b. Process Radiation Monitors
c. Area Radiation Monitors
d. Data Acquisition Subsystem
e. Data Processing Subsystem
f. Alarm and Display Subsystem
g. Scintillation detectors
h. Geiger Mueller detectors
i. Ionization chamber detectors

EO-3.0 State the setpoint and purpose for the following interlocks:

a. Reactor Building ventilation auto isolation.
b. Standby gas auto initiation and isolation.
c. Control Room ventilation auto isolation.
d. Liquid Radwaste Effluent auto isolation.
e. Off Gas pretreatment auto isolation.

EO-4.0 Describe the interrelationship between the Digital Radiation Monitoring System and the following systems. |6

a. Control Room Ventilation
b. Reactor Building Ventilation
c. Service Water
d. Primary Containment
e. Reactor Building Closed Loop Cooling Water
f. Turbine Building Closed Loop Cooling Water
g. Circulating Water
h. Standby Gas Treatment
i. Turbine Building Ventilation
j. Radioactive Liquid Waste
k. Offgas System
l. Spent Fuel Pool Cooling
m. Solid Radioactive Waste

EO-5.0 Explain the basis for each precaution and limitation listed in N2-OP-79.

EO-6.0 Regarding the Digital Radiation Monitoring System, determine and use the correct procedure to identify the actions and/or locate information related to:

a. Startup
b. Shutdown
c. Normal
d. Off Normal
e. Annunciator Response procedures

EO-7.0 Given a specific set of plant conditions, determine how the Digital Radiation Monitoring System responds.

EO-8.0 Given a specific set of plant conditions, describe the immediate operator actions required.

EO-9.0 Describe how the Digital Radiation Monitoring System is utilized during the performance of the EOP's.

EO-10.0 (SRO Only) Given NMP2 Technical Specifications and a set of plant conditions, determine the appropriate bases, limiting condition for operations, limiting safety system setting, and/or action statement as appropriate.

VI. LESSON CONTENT LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
I. INTRODUCTION		
	Preliminary Activities: Introduce self to class if unfamiliar. Circulate Training Record for completion. Pass out copies of objectives. Describe daily quizzes and weekly exams. Pass out Course Evaluation Sheets and explain their use.	|6
A. Trainee Learning Objectives	Review trainee learning objectives.	
B. System Purpose The Radiation Monitoring System (RMS) collects and processes data from radiation monitoring sensors throughout the plant. It incorporates the functions of an Area Radiation Monitoring System (ARM) and a Process Radiation Monitoring System (PRM). The Area Radiation Monitoring System monitors, records and provides alarms for radiation levels in selected plant areas. The Process Radiation Monitoring System monitors, records and provides alarms for radioactivity or concentration levels in potentially radioactive effluents or process streams. The systems also initiate appropriate protective action to limit the uncontrolled release of radioactive materials to the environment.		EO-1.0 |6

C. General Description

1. The Radiation Monitoring System encompasses two functional groups: EO-2.0 |6
   a. Area Radiation Monitoring System (ARM)
   b. Process Radiation Monitoring System (PRM)
2. PRM and ARM are brought together under the Digital Radiation Monitoring System (DRMS). DRMS has 4 operational subsystems: Show TP-1 (Figure - 1 of N2-OLT-62.) Point out system as discussed. |6 |
   a. Radiation Detection
   b. Data Acquisition
   c. Data Processing
   d. Alarm and Data Display
3. Area Radiation Monitoring
   a. Reports and records abnormal gamma radiation levels in areas where radioactive materials may be stored, transported or inadvertently introduced.
   b. Has warning alarms for high radiation and channel failure, but does not initiate any protection or control functions.
   c. Most of the area radiation monitors are Geiger-Mueller tubes. The rest are ionization Chambers. Low and Medium Ranges - Geiger Mueller High Ranges - Ionization Chamber |6 |

d. Output from radiation monitors goes to their associated microcomputer data processor, then to the central computer which feeds display terminals in the control room and other important stations.

4. Process Radiation Monitoring

a. Monitors radiation levels in potentially contaminated liquid process streams, gaseous process streams and the airborne radioactivity levels in potentially contaminated ventilation ducts using 33 monitors.

b. When a radioactivity setpoint is exceeded:

1) The condition is annunciated in the control room.

2) Trip signals automatically close isolation valves to prevent release of radioactivity to the environment.

c. The processing of signals from the PRM detectors is the same as the ARM's.

d. Some monitors sample a small portion of the process stream while others measure the radiation emanating from the pipe.

Inform trainees that monitors will be discussed in detail later in the lecture.

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
5. Radiation Detection Subsystem a. Consists of ARM's and RPM's	Show TP-1 (Figure 1 of N2-OLT-62)	6
6. Data Acquisition Subsystem a. Consists of Data Acquisition Units 1) Serve as the interface between the monitors and processors. 2) Provides local indication and alarm functions.	Point out subsystems as discussed.	
7. Data Processing Subsystem a. Receives data from the radiation monitors via the Data Acquisition Subsystem. b. Generates displays, logs and reports. c. Provides for storage of the data in memory.		
8. Alarm and Data Display Subsystem a. Consists of: 1) Safety related (Category I) Auxiliary Control Units 2) Related controls 3) Alarms 4) Recorders in the control room on the Process and Area Radiation Monitoring Panel PNL880.		

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
II. DETAILED DESCRIPTION		
A. Radiation Monitors	Show TP-1 (Figure-1 of N2-OLT-62) and point out radiation monitors.	EO-2.0a |6 |
1. Function		
a. Detect and respond to the presence of radioactivity in a system or area.		
b. Measure the level or concentration of radioactivity.		
c. Electronically transmit information on radioactivity to the data acquisition and processing subsystems.		
2. Types (7)		EO-2.0b
a. Off-Line gas monitors	Show TP-2 (Figure 11.5-2 of USAR Chapter 11.5). Point out individual components as discussed.	|6 | |
1) Used in the Control Room air intake ducts, the Standby Gas Treatment system discharge, the Off-Gas system pretreatment lines and the Reactor Building Ventilation ducts from above and below the refueling floor.		
2) Detector is a beta scintillation counter.	Explain the operator of a scintillation detector.	EO-2.0g |6 |
3) Continuously withdraws a sample through an isokinetic nozzle within the ventilation duct.	Show flowpath thru monitor.	|6

	4) The sample gas is drawn through charcoal and particulate filter cartridges, through the sample chamber where it is counted and returned to the process stream by a sample pump.		
	5) The filters are removable for laboratory analysis..		
	6) Detector circuit continuity is periodically verified using a remotely operated check source.		
	7) Gas sample chamber and sample tubing can be purged remotely with air.	Purges prevent the build up of fall-out in the sample lines and prevent sample cross contamination.	6
b.	Off-line gas and particulate monitors	Show TP-3 (Figure 11.5-1 of USAR.	6
	1) Used to monitor activity in the drywell atmosphere.	Section 11.5) Point out monitor components as discussed.	
	2) A sample pump draws air from the drywell through a moving filter paper, removable charcoal filter cartridges, a gas sample chamber and returns it to the drywell.	Show sample flowpath.	

3) Particulate activity accumulating on the filter paper is counted by a beta scintillation detector.

4) Airborne activity is monitored in the sample chamber by a separate detector.

5) There are connections for taking grab samples of the process stream and for taking samples downstream of the filters for tritium analysis.

Q: Why is the isotope tritium a major concern? |6

A: Because it is chemically identical to natural hydrogen, tritium can easily be taken into the body by any ingestion path.

6) Use of check sources and purging is similar to the off-line gas monitors.

c. On-line liquid or gas monitors

Show TP-4 (Figure 11.5-4 of USAR. Section 11.5) Point out monitor components as discussed. |6

1) Use ion chamber radiation detectors.

2) Monitor radwaste feed to the extruder/evaporators. |6

3) Mounted directly on the outside of the pipe being monitored. No contact with the process fluid.

4) Shielded to minimize the effect of background radiation.

	5) Provided with check sources for circuit continuity checks.		
d.	Off-line liquid monitors	Show TP-5, 6 (Figures 11.5-3A and 3B.)	6
	1) Scintillation detectors count the activity in a liquid sample chamber.	Point out monitor components as discussed.	
	2) A continuous liquid sample is drawn through a sample chamber from the following sources: Service Water side of the Residual Heat Removal heat exchanger Service Water system discharge, Fuel Pool Cooling pumps discharge, Turbine Building Closed Loop Cooling Water, Reactor Building Closed Loop Cooling Water, Liquid Radwaste effluent and Cooling Tower blowdown.		

	3) A pump inside the monitor unit returns the sample fluid to its system of origin.		
	4) Heat exchangers cool the samples from high temperature systems.	Prevents liquid from flashing to steam.	6
	5) Each detector has its own integral check source.		
e.	On-line isotopic monitors (GEMS)	Show TP-7 (Figure 11.5-5 of USAR	6
	1) Three detectors within the on-line isotopic monitor check for iodine, noble gases, and particulate activity.	Section 11.5.)	
	2) They are used for the effluent of the main stack and the reactor building ventilation system exhaust.	Point out components as discussed.	6
	3) The monitor automatically purges itself with air and performs daily maintenance routines such as background checks, source checks and diagnostic checks.		
	4) Monitors controlled by a separate microcomputer on T.B. 306' elevation (counting room) and they print out in the control room, TSC and EOF.		

f. Portable continuous air monitor (CAM)

1) Mounted on a wheeled carriage to transport whenever needed.

Show TP-8 (Figure 11.5-6 of USAR Section 11.5.)

2) Scintillation detectors monitor for noble gas and particulates.

Point out components as discussed.

3) A removable charcoal filter allows sampling of iodine.

4) Monitors process ventilation systems and local area ambient airborne activity.

5) Fixed isokinetic probes on the CAM are used to monitor ventilation systems.

6) Computer interface capability is provided through remote terminal connections.

g. Area Radiation Monitors

EO-2.0c

1) Five different models to cover five different ranges of radiation level.

2) The ARM detectors measure gamma radiation levels in the detector's general area.

Low Ranges:
10^{-2} to 10^{3} mrem/hr
10^{-1} to 10^{4} mrem/hr
1 to 10^{5} mrem/hr

High Ranges:
10 to 10^{8} mrem/hr
1 to 10^{7} rem/hr

LESSON CONTENT	DELIVERY NOTES	OBJECTIVES/ NOTES
3) Geiger-Mueller chambers are utilized for the 3 low ranges and ionization chambers for the 2 high ranges.	If necessary, explain the operation of GM and Ion Chamber detectors.	EO-2.0h EO-2.0i
4) Each of 58 detectors in the plant has its own integral check source.		
B. Data Acquisition Subsystem (DAS)		EO-2.0d
1. Each radiation monitor in the plant has an associated microcomputer physically located near the detector.	Show transparency of Figure 1 of N2-OLT-62. Point out DAS.	6
2. Each microcomputer incorporates two sub-units of the Data Acquisition Subsystem, one of which is the Data Acquisition Unit (DAU).		
3. Data Acquisition Unit (DAU)	Point out DAU	6
a. The DAU calculates the radioactivity or radiation present and displays the results.	Show transparencies of attachments 10 thru 13 of N2-OP-79. Explain component operation.	6
C. Data Processing Subsystem Composed of:		EO-2.0e
1. Central Processing Units		
a. Located in the Computer Room		
b. Consists of two redundant units		

c. Relay information and commands between operators control stations and data acquisition processors. |6

2. Five display units (CRT's)

3. Five receive only printers

a. Provide a hard copy printout of radiation monitoring data hourly or on demand.

4. Two printers with send and receive capability.

D. Alarm and Data Display Subsystem (Control Room panel PNL880) EO-2.0f

1. Applies only to the safety related, Category 1 radiation monitors.

2. Consists of:

a. Divisional auxiliary control units

b. Pen recorders in the control room

c. Process and Area Radiation Monitoring Panel

3. Auxiliary Control Units

a. Receives data from the associated Data Acquisition Unit for display and alarm.

b. Provides remote controls for all DAU operations.

Show transparencies of Attachment 6 of N2-OP-79 (Keric P880 Recorders). Point out and discuss each monitor and system monitored. |6

Monitors are designed to Category I criteria to withstand natural phenomena. (e.g., earthquakes). |6

Monitors meet the reliability, testability, independence and failure mode criteria of Engineered Safety Features (ESF). |6

c. Can provide input to one of the pen recorders in the control room panel PNL880.

III. INSTRUMENTATION, CONTROL AND INTERLOCKS

A. Instrumentation

1. Control room instrumentation for the Area and Process Radiation Monitoring systems located on panel 880 and the Operator's Console.

B. Controls

1. Located on Operator's Console in the Control Room.

C. Interlocks

1. Reactor Building Ventilation Above and Below Refueling Floor

Setpoint 1.7 X 10^{-3} uci/ml.

EO-3.0a |6
EO-3.0b |

a. On a high radiation alarm signal, the exhaust flow path is isolated and the reactor building air is recirculated. A small fraction of the air is diverted and exhausted through the Standby Gas Treatment System (SGTS) which auto initiates on same signal.

2.	Main Control Room Air Intake		EO-3.0c |6
	a. If the activity of the unfiltered control room intake air reaches the high radiation setpoint of the radiation monitors, the air is diverted through a HEPA and charcoal filter train.	Setpoints: High alert - 2 X 10^{-6} uci/ml High high alarm - 5.15 X 10^{-6} uci/ml	|
3.	Liquid Radwaste Effluent	Setpoint 9.4 x 10^{-4} uci/ml	EO-3.0d
	a. Isolates radwaste effluent on high radiation level.		
4.	Standby Gas Treatment Discharge		|6
	a. The off-line gas monitor installed on the discharge of the Standby Gas Treatment System isolates the normal containment purge path on high radiation level.	Setpoint 5.7 X 10^{-3} uci/ml	EO-3.0b
5.	Off-gas Pretreatment		EO-3.0e |6
	a. The offgas process flow upstream of the charcoal bed absorbers is monitored by offline gaseous monitors. These monitors isolate the offgas effluent following receipt of a high radiation signal.	Setpoint High Alert - 9.9 uci/ml High Alarm - 57 uci/ml Shuts AOV 1A and 1B, AOV-11A and 11B	| |

IV. SYSTEM INTERRELATIONS — EO-4.0 | 6

A. Control Room Ventilation - monitored by four off-line gas monitors on control room air intake ducts. — EO-4.0a

B. Reactor Building Ventilation - monitored by four off-line gas and particulate monitors; one each for above and below refueling floor exhaust paths. — EO-4.0b

C. Service Water - monitored by four off-line liquid monitors; one at each Residual Heat Removal heat exchanger outlet, two on the system discharge line. — EO-4.0c

D. Primary Containment - atmosphere monitored by two off-line gas and particulate monitors; also monitored by four post-accident area radiation monitors. — EO-4.0d

E. Reactor Building Closed Loop Cooling Water - monitored by two off-line liquid monitors. — EO-4.0e

F. Turbine Building Closed Loop Cooling Water - monitored by one off-line liquid monitor. — EO-4.0f

G. Circulating Water - monitored on cooling tower blowdown line by one off-line liquid monitor. — EO-4.0g

H. Standby Gas Treatment - monitored on discharge line by one off-line gas monitor. — EO-4.0h

I. Turbine Building Ventilation - a connection tap is provided in the system exhaust ductwork for a portable Continuous Air Monitor. — EO-4.0i

J. Radioactive Liquid Waste - monitored by off-line liquid monitor in the effluent line. EO-4.0j

K. Offgas - monitored before charcoal bed adsorbers (pretreatment) by two off-line gaseous monitors. EO-4.0k

L. Spent Fuel Pool Cooling - monitored by off-line liquid monitor at filter inlet. EO-4.0l

M. Solid Radioactive Waste - monitored by on-line liquid radiation monitors; one each for waste sludge feed and waste concentrates feed to extruder/evaporator. EO-4.0m

V SYSTEM OPERATION

A. Normal Operation

1. The RMS passively monitors the radiation levels at its process and area monitors and prints out hourly averages of all the monitored stations.
2. It also provides a display containing information on the safety-related category I monitoring channels at the operator's console and provides a full screen display of radiation channels grouped by areas of the plant when requested.

3. A group display function is also available which groups monitors by the function they perform. Operators can also create their own group by commanding the CRT to display the readings of the specific channels he or she wants to monitor.

B. Emergency Operation

When a radiation monitor's reading exceeds its "alert" or its high radiation alarm setpoint, an annunciator is received in the control room.

VI. DETAILED SYSTEMS REFERENCE REVIEW

Review each of the following referenced documents with the class.

A. Procedures

1. N2-OP-79, Radiation Monitoring System
2. N2-EOP-RRC, Radioactivity Release Control
3. N2-EOP-SCC, Secondary Containment Control

B. Technical Specifications

1. 3/4.3.7.1, Radiation Monitoring
2. 3/4.3.7.10, Radioactive Liquid Effluent
3. 3/4.3.7.11, Radioactive Gaseous Effluent Monitoring Instrumentation

Discuss the following with the trainees. Precautions and limitations, startup, shutdown normal and abnormal operations and alarm response procedures. Utilize EOP Basis document to discuss usage during EOP conditions. Discuss the listed LCO's including applicable modes, action statements, and surveillance requirements.

EO-5.0 | 6
EO-6.0a-e |
EO-7.0 |
EO-8.0 |
EO-9.0 |
|
EO-10.0

VII. RELATED PLANT EVENTS

A. Review the following LER's with the class.

1. LER 91-09
2. LER 90-24
3. LER 90-23
4. LER 90-22
5. LER 89-34

VIII. SYSTEM HISTORY

A. No Mods listed.

IX. WRAP-UP

A. Review the Student Learning Objectives.